The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

New Dept. of Energy Priority-Setting Analysis Seriously Flawed

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The US Department of Energy (DOE) recently issued a report called Report on the first Quadrennial Technology Review (QTR), which has as its purpose helping the DOE choose among conflicting priorities.

The new report sets priories based on a distorted view of the future. One issue is that it is trying to set priorities based on an overly optimistic view of energy supply presented in the EIA's International Energy Outlook 2011 (IEO 2011). Another issue is that it overlooks the way the US and world economy can be expected to change as a result of lower oil and natural gas supply. A third issue is that its view of climate change mitigations is based on a view of fossil fuel supply that is far greater than is likely to be the case.

The DOE needs to re-think its priorities for an entirely different kind of world--a world of energy scarcity. In a world of energy scarcity, citizens are poorer and less able to pay for basic services, much less higher-priced services. Maintaining basic transportation and electrical services for as much of the population as possible needs to be a top priority. Some government agency, presumably the DOE, will need to make certain that rationing systems are set up so that essential industries get the fuel they need and essential workers are able to obtain transportation to work.

This change in approach in priority-setting requires a very different mind-set than is currently being promulgated through the press. Let me start by explaining where we are today.

Where we are today

Oil and Substitutes. If we believe the QTR, global "liquids" production (oil and oil substitutes, like biofuels) will begin rising to 110 million barrels a day, after its flat period since 2005.

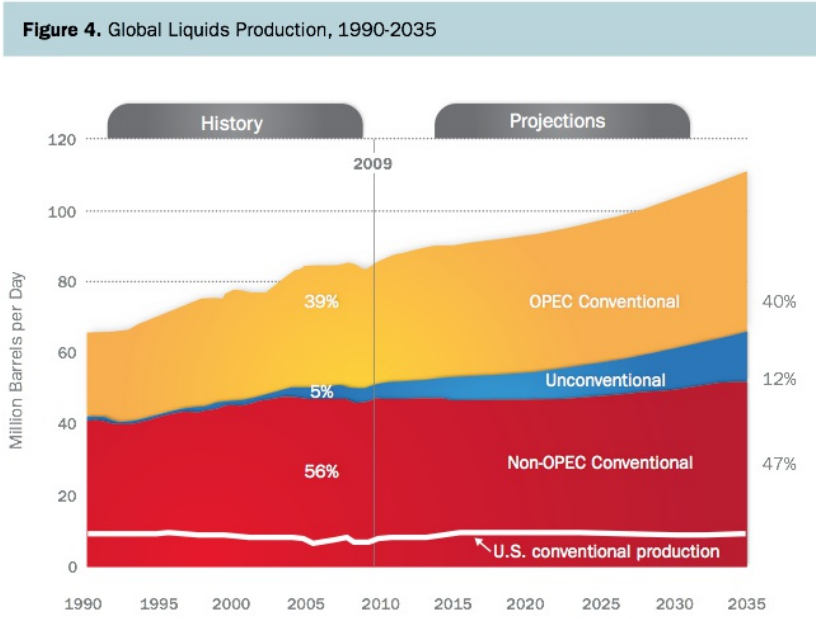

Figure 1. Global Liquids Production from QTR

Data in Figure 1 is based on IEO 2011. I recently wrote a post called IEO 2011: A Misleadingly Optimistic Energy Forecast by the EIA, explaining why the forecast is unrealistic. Among other things, oil prices would need to be much higher than EIA is forecasting to reach the production amounts shown in Figure 1. Unfortunately, these high oil prices would lead to recession and economic decline, resulting in lower oil consumption. Because of these issues, the increase in production shown above is not feasible. In fact, I would expect a **decrease in production** by as much as 50% by 2035.

Many people do not understand the issues behind the likely decline in oil production. There is plenty of oil in the ground--this is **not** the issue. The problem is that the oil that is left (such as that in the Bakken and in the oil sands) is slow and expensive to extract, because the "easy-to-extract" oil was mostly removed first. There is plenty of demand for low-priced oil, but high-priced oil tends to "choke" the economy, leading to recession. James Hamilton has shown that 10 out of 11 US recessions since World War II were associated with oil price spikes.

Some people would describe the phenomenon as "peak oil," but I am not sure that this is the best description of the issue. The problem is that the price of oil is increasingly high, partly because of the high cost of extraction, and partly because governments of the countries where the oil is extracted are increasingly "needy," and require high taxes on oil companies to meet their budgets.

High-priced oil tends to choke economies because high oil prices are associated with high food prices (because oil products are used in food growing and transport), and people's salaries do not rise to offset this rise in food and oil prices. People have to eat and to commute to their jobs, so they cut back on other expenditures. This leads to recession. Recession leads to lower oil consumption, since people without jobs can't buy very much of anything, oil products included. In some sense, the reduction in oil extraction is due to reduced demand, because citizens cannot afford the high-priced oil that is available.

Natural Gas. If we believe QTR, US natural gas consumption is expected to rise modestly by 2035, because of a huge increase in shale gas production. IEO 2011 indicates the expected natural gas consumption increase to 2035 is 10% (24.1 tcf in 2010; 26.5 tcf in 2035).

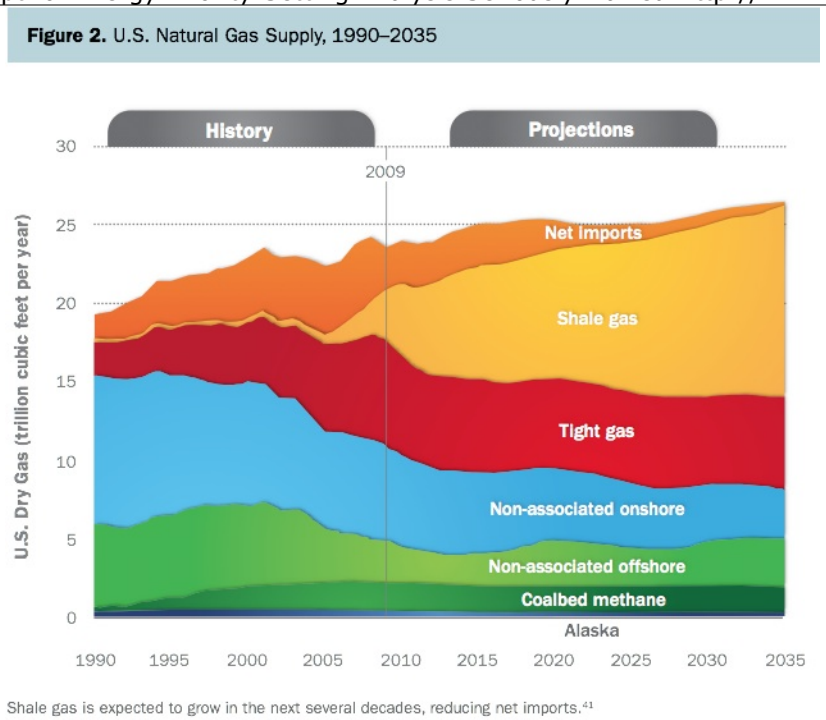

Figure 2. US Natural Gas Supply according to QTR.

The huge increase in shale gas shown in Figure 2 is by no means assured. The United States Geological Survey recently produced an estimate of Marcellus Shale resources, which will cause the EIA to reduce its estimate of shale gas reserves for the Marcellus Shale by 80%. There is also considerable uncertainty about long-term decline rates of wells, which would make a major difference in the ultimate recovery of wells. Furthermore, there are concerns regarding whether fracking and disposal of waste water can be done safely, especially near highly populated areas.

If shale gas production in fact decreases, Figure 2 suggests that US natural gas consumption could drop by as much as 30% or 35% by 2035, rather than rising. So there is a wide range of possible outcomes, with DOE's optimistic estimate being a 10% increase in US natural gas consumption. US natural gas consumption is smaller than oil consumption (about 68% as much), so the 10% increase in natural gas consumption would do very little to offset the likely oil supply decrease between now and 2035.

As with oil, there is an economic issue in all of this. How high can natural gas prices rise, without inducing huge recession? How long can shale gas producers "hang on" if natural gas prices are as low as they are now? Without higher prices, there is not much incentive to produce shale gas. If there is recession because of high **oil prices**, this may cut into demand for natural gas, because laid-off workers cannot afford products made with natural gas, either.

Liebig's Law of the Minimum Effect. If we think of the economy as a "system," it is very difficult to make changes to the economy quickly. We have a huge number of cars, trucks, trains, farm equipment, heavy construction equipment, and airplanes that are not designed to run on anything other than petroleum products. There is no way to change to another energy source for this equipment in the next several years because of the research timeline and the cost of building replacement equipment.

If there is inadequate oil, what happens is that oil prices rise. Because of the long timeframe required to change existing equipment to use other fuels, the rise in oil prices leads to recession. Recession cuts back on demand for **all** energy products, not just the oil that is in short supply.

If we think of the economy as a system, and oil as a necessary input, this is really an application of Liebig's Law of the Minimum. In agriculture, this law says that if a necessary nutrient is lacking, overall output will be reduced in proportion to the amount of the limiting nutrient. With the economy, if there is not enough oil (reflected in high oil price), the rest of the economy is restricted as well--the amount of electricity used; the number of workers employed; the amount of new loans outstanding; the demand for new homes, etc. This seems to be what happened in the 2008-2009 recession, and is threatening to happen again.

Climate Change. Climate change models do not assume that fossil fuels are a limiting factor before 2100. If more realistic amounts are assumed, the CO_2 amounts forecast will be much lower. See for example this estimate by De Sousa and Mearns. If fossil fuel limitations were reflected in the models, the indicated temperature rise would be lower. If the indicated temperature change is lower and if fossil fuel use is declining rapidly regardless of what happens, the need for climate change mitigations would appear to be lessened.

Carbon Capture and Storage (CCS). CCS burns fuel more rapidly than today's approaches, because of the large amount of energy used for sequestration. If oil and natural gas are in limited supply to begin with, CCS is likely to cause us to exhaust the economically feasible supply sooner. Adding CCS also tends to make the cost of electricity higher. Because of theses issues, CCS research should probably be halted, and CCS options should be removed from consideration in the choice of future fuel sources.

Renewables vs Fossil Fuel Extenders. "Renewables" such as wind, solar PV, cellulosic ethanol, and biogas could more accurately be called "fossil fuel extenders" because they cannot exist apart from fossil fuels. Fossil fuels are required to make wind turbines and other devices, to transport the equipment, to make needed repairs, and to maintain the transport and electrical systems used by these fuels (such as maintaining transmission lines, running-back up power plants, and paving roads). If we lose fossil fuels, we can expect to lose the use of renewables, with a few exceptions, such as trees cut down locally, and burned for heat, and solar thermal used to heat hot water in containers on roofs.

What the DOE Should be Focusing On

We do not know precisely how soon oil and natural gas supplies will be declining, but it would seem to be worthwhile to start preparing now. It is clear we are already running into recessionary forces. Since these recessionary forces are tied in with high energy prices, they can only be expected to get worse with time, rather than better. The two major issues I see are

1. We need to keep some form of transportation system operating as long as possible.

2. We need to keep some form of electrical system operating as long as possible, probably transitioning to only local electricity.

What do we need to do to accomplish these goals?

This is too complex an issue to handle fully in a single post, but let me point out a few things that I can perhaps expand upon in later posts.

Low-Priced Oil Substitutes. The DOE should be focusing on dealing with a world that is in long-term recession, with many people unemployed, and governments limited in their ability to pay subsidies. Since a major reason for recession seems to be high oil prices, it would seem to be clear that any substitute for oil that is more expensive is likely to make the situation worse. What we need is oil substitutes that cost $50 barrel or less--cheap substitutes--to help counter the recessionary force of high oil prices. The idea of waiting until oil prices rise, so that some high-

priced substitute is competitive, is ridiculous.

Remove subsidies. High energy costs lead to economic contraction. This is true even if the true cost is "buried" through subsidies or feed-in tariffs, because the true cost must be paid, one way or another, either directly, or indirectly, through higher taxes. Subsidies relating to high-priced energy products tend to increase the amount of high-priced energy consumed, so are counterproductive from an economic point of view, unless the subsidy is temporary, and truly leads to a lower-cost energy product.

Alternative Transportation. As the economy encounters more and more recession, fewer will be able to afford to drive. Because of this, there will be a need to provide transportation for poorer people, without adding huge costs to the system. Car pool systems would probably make more sense than adding buses, but buses might be helpful as well. Substituting bicycles for cars would be another worthwhile approach.

People will be giving up their cell phones, not adding them, so systems for using car pools should be simple ("Pick up a rider if you have room, and are going that way") not technically complex ("Call on your cell phone, and an operator will log you into a registry and send a vehicle your way.") Furthermore, technically complex approaches depend on oil for their maintenance and repair, so are more inclined to breakdowns over the long term.

Long-Term Maintenance of the Highway System. As oil becomes less available, highway maintenance will likely become more expensive. At the same time, the number of vehicles using the roads will likely be decreasing. Vehicles that do operate will use a variety of fuel sources--gasoline, diesel, electricity, and natural gas. In such a situation, an efficient approach for collecting needed funds for maintenance might be to use more toll roads. Eventually, as costs become too high, some roads will need to be changed back to gravel, or no longer be maintained.

Long Distance Electrical Grid. The electric grid was never set up for long distance transport of electricity, but in recent years, we have been attempting to use it for this purpose. If we want to use it for this purpose, and in fact upgrade it to add wind and solar production, it seems to me that some governmental organization needs to take ownership of the long distance transmission system. This organization needs to charge fees to long-distance users of these lines, analogous to tolls for highway use, to obtain adequate funds for maintenance, upgrades, and electricity storage. These fees will tend to raise the cost of wind and solar electricity.

Maintenance of the electric grid is petroleum dependent, so costs can be expected to rise over time. At some point, we may find it too difficult to maintain long-distance lines (because of inability to obtain fuel for repairs using helicopters, for example), and may need to abandon some long distance transmission. We need to plan our long-distance electrical use with this in mind. It may make sense to go back to more of a vertically integrated electrical utility model, applicable to individual communities, instead of a system based on long-distance trading. As with "local food," perhaps we need to be thinking of "local electricity".

Solidity of the Electrical System. The electric system and the oil-based transport system are very interdependent. Oil is needed for maintenance of roads and electric transmission lines. At the same time, if there is an electrical outage, oil and gas pipelines stop running, so gasoline stations lose their supplies. Furthermore, pumps at the gasoline stations don't work without electricity. Thus, if we lose one, we lose the other.

We keep making demands of the electrical system that the system was not originally designed to handle--for example, to incorporate more renewable energy; to run the system with less slack through the use of "smart meters," and to sell electricity long-distance using competitive pricing. It seems to me that there needs to be an organization that oversees the electrical system from

the point of view of what really makes sense for the system. With the current ad hoc system, even basic maintenance is a problem--much of the transmission system was built in the 1960s, and is beyond its expected lifetime.

Some of the problem areas may be indirect. For example, if the pricing system for wind and solar electricity causes financial problems for companies generating electricity using natural gas and coal, this could lead to the bankruptcy of operators needed to keep the overall system working. In Europe, where more wind and solar PV are used than in the US, the pricing system already seems to be having an adverse impact on companies generating electricity using fossil fuels.

Rationing. At some point, rationing may be needed for both oil products and for electricity usage. The DOE should probably be the one coordinating planning for this contingency. Even if rationing is not needed for quite a few years, planning the details ahead of time would seem to be helpful.

Adapted from a post at Our Finite World.